CLAIMS

1. A system for manufacture of flat panel displays comprising:

a plurality of manufacturing devices located in a first controlled environment, at least some of said plurality of manufacturing devices each including an enclosure defining a second controlled environment different from said first controlled environment; and

a plurality of optical inspection devices operative to inspect flat panel display substrates at various stages of the production thereof by said plurality of manufacturing devices, at least some of said plurality of optical inspection devices being located within said enclosures defining said second controlled environments.

2. A system for manufacture of flat panel displays comprising wherein the first controlled environment is an airborne particle controlled environment having a first level of controlled airborne particulate contamination, and the second controlled environment is an airborne particle controlled environment having a second level of controlled airborne particulate contamination that is less than the first level of controlled airborne particulate contamination.

3. A system for manufacture of flat panel displays according to claim 1 or claim 2 and wherein said plurality of optical inspection devices are operative in coordination with said plurality of manufacturing devices for inspecting said substrates prior to transfer thereof out of said second controlled airborne particle contamination environment.

4. A system for manufacture of flat panel displays according to either of the preceding claims and wherein at least some of said plurality of optical inspection devices comprise non-scanning sensors.

5. A system for manufacture of flat panel displays according to any of the preceding claims and wherein said plurality of optical inspection devices are operative to identify fabrication process defects occurring during production of flat panel display substrates.

6. A system for manufacture of flat panel displays according to claim 5 and wherein said process defects include at least one of the following: uneven deposition of coatings, uneven removal of coatings, rinse residues, chemical residues, incomplete exposure of a photo-resist deposited on the substrate, scratches, lines, and particles embedded in the substrate.

7. A system for manufacture of flat panel displays according to any of the preceding claims and wherein each of said plurality of optical inspection devices includes at least one non-scanning sensor which views substantially all of the surface of said substrate.

8. A system for manufacture of flat panel displays according to claim 7 and wherein the at least one non-scanning sensor comprises a plurality of non-scanning sensors wherein each sensor views a portion of the substrate and together the plurality of sensors views substantially the entire surface of said substrate.

9. A system for manufacture of flat panel displays according to any of the preceding claims and wherein each of said plurality of optical inspection devices comprises an illuminating array operative to provide various combinations of illumination.

10. A system for manufacture of flat panel displays according to claim 9 in which the combinations include at least dark field and substantially bright field illumination.

11. A system for manufacture of flat panel displays according to claim 9 in which the non-scanning sensor acquires at least one image of the substrate for each combination of illumination.

12. A system for manufacture of flat panel displays according to claim 11 and also comprising an image analyzer for identifying process defects by computer analysis of a plurality of image of the substrate taken under various ones of said combinations of illumination.

13. A system for manufacture of flat panel displays according to claim 12 and wherein said image analyzer is operative without comparison to an external reference.

14. A system for manufacture of flat panel displays according to any of the preceding claims and wherein said enclosure contains a first plurality of illuminators mounted on a first wall of said enclosure and a second plurality of illuminators mounted on a second wall of said enclosure, orthogonal to said first wall.

15. A system for manufacture of flat panel displays according to any of the preceding claims and also comprising directionally adjustable illuminators..

16. An inspection system for use in inspecting flat panel displays comprising:

a non-scanning optical array for viewing a flat panel display substrate; and

an illumination subsystem sequentially providing dark field and bright field illumination of said flat panel display substrate when said optical array views at least a part of said flat panel display substrate.

17. An inspection system according to claim 16 and wherein said illumination subsystem provides various combinations of dark field and bright field illumination of said flat panel display substrate when said optical array views said flat panel display substrate.

18. An inspection system according to claim 17 and wherein said dark field and said bright field illumination are diffuse .

19. An inspection system according to claim 17 and wherein said dark field and said bright field illumination are focussed.

20. An inspection system according to claim 19 and wherein said flat panel display substrate has a surface that includes a periodic spatial feature, and said dark field and said bright field illumination are diffracted by said spatial feature.

21. An inspection system according to any of claims 17 – 20 and also comprising a spatially positionable stage to support the flat panel display substrate, wherein the stage spatially positions the substrate at various angles relative to the illumination subsystem.

22. An inspection system according to claim 21 and wherein the optical array, illumination subsystem and stage are configured and arranged to selectively enable viewing the flat panel display substrate such that a non-zero'th order of diffraction impinges on the non-scanning optical array.

23. An inspection system according to claim 22 and wherein a multiplicity of the non-zero'th orders of diffraction of a similar order impinge on said non-scanning optical array.

24. An inspection system according to either of claims 22 and 23 and wherein the optical array, the illumination subsystem and the stage are configured and arranged to additionally enable selectively viewing the flat panel display substrate such that a zero'th order of diffraction impinges on the non-scanning optical array.

25. An inspection according to any of claims 22 – 24 and wherein the optical array the illumination subsystem and the stage are configured and arranged to additionally enable selective viewing of the flat panel display substrate such that substantially no orders of diffraction impinge on the non-scanning optical array.

26. An inspection system according to claim 25 and wherein the optical array and the illumination subsystem are configured and arranged to sequentially view the flat panel display substrate and wherein in one view a selected non-zero'th order of diffraction impinges on the optical array, and in other each sequential views at least one of the following impinges on the optical array: a zero'th order of diffraction, an additional selected non-zero'th order of diffraction, no order of diffraction, the same non-zero'th order of diffraction of a different region of the article.

27. An inspection system according to any of claims 21 – 26 and also comprising an image analyzer receiving an output from said non-scanning optical array and being operative to detect process defects including at least one of: uneven deposition of coatings, uneven removal of coatings, rinse residues, chemical residues, incomplete exposure of a photo-resist deposited on the substrate, scratches, lines, and particles embedded in the substrate.

28. An inspection system according to any of claims 17 – 18 and wherein said optical array views substantially all of a surface of said substrate.

29. An inspection system according to any of claims 17 – 18 and wherein said optical array views only part of a surface of said substrate.

30. An inspection system according to any of claims 17 - 29 and wherein said optical array acquires at least one image of said substrate for each of a plurality of different illuminations.

31. An inspection system according to claim 27 in which an image analyzer identifies said defects by computer analysis of a plurality of images of said substrate taken under differing illumination.

32. An inspection system according to any of claims 17 – 21 and also comprising an enclosure containing a first plurality of illuminators mounted on one wall thereof and a second plurality of illuminators mounted on a second wall thereof.

33. An inspection system according to claim 32 and also comprising a third illuminator mounted on a third wall of said enclosure.

34. An inspection system according to any of claims 17 – 23 and also comprising a diffuser associated with said illumination subsystem.

35. An inspection system according to any of claims 17 – 21 and also comprising a light source and a reflector operative to provide concentrated light from the light source to at least part of said flat panel display substrate.

36. An inspection system according to claim 35 wherein said reflector has two points of focus, and wherein a projector is situated at a first of points of focus, and the second point of focus is situated away from the flat panel display substrate.

37. An inspection system according to claim 36 and wherein the reflector is a section of an ellipsoid.

38. An inspection system according to claim 36 and wherein the reflector is flat and is operatively associated with a lens.

39. An inspection system according to claim 38 and wherein the lens is a fresnel lens attached to the reflector.

40. An inspection system according to any of claims 17 – 21 and also comprising a light source and a lens operative to provide concentrated light from the light source to at least part of said flat panel display substrate.

41. An inspection system according to claim 40 wherein the projector is situated at a first focus of the lens, and a second focus of the lens is situated away from the flat panel display substrate.

42. An inspection system according to any of claims 17 – 41 and comprising an adjustable mounting assembly for selectably determining at least one of relative inclination, spatial separation and axial orientation of at least two of said optical array, said illumination subsystem and said substrate.

43. An inspection system for use in inspecting surfaces of articles comprising:

a non-scanning optical array for viewing a surface of an article; and

an illumination subsystem sequentially providing dark field and bright field illumination of said surface while said optical array views said surface.

44. An inspection system according to claim 43 and wherein said illumination subsystem provides various combinations of dark field and bright field illumination of said surface when said optical array views said surface.

45. An inspection system according to claim 44 and wherein said dark field and said bright field illumination are diffuse .

46. An inspection system according to claim 44 and wherein said dark field and said bright field illumination are focussed.

47. An inspection system according to claim 46 and wherein said surface includes a periodic spatial feature operative to diffract light impinging thereon.

48. An inspection system according to any of claims 43 – 47 and also comprising a spatially positionable stage to support the article, wherein the stage spatially positions the article at various angles relative to the illumination subsystem.

49. An inspection system according to claim 48 and wherein the optical array, illumination subsystem and stage are configured and arranged to selectively enable viewing the surface such that a non-zero'th order of diffraction impinges on the non-scanning optical array.

50. An inspection system according to claim 49 and wherein a multiplicity of non-zero'th orders of diffraction of substantially the same order impinge on the non-scanning optical array.

51. An inspection system according to either of claims 49 and 50 and wherein the optical array, the illumination subsystem and the stage are configured and arranged to additionally enable selectively viewing of the surface such that a zero'th order of diffraction impinges on the non-scanning optical array.

52. An inspection according to any of claims 49 – 51 and wherein the optical array the illumination subsystem and the stage are configured and arranged to additionally enable selectively viewing the object such that substantially no orders of diffraction impinge on the non-scanning optical array.

53. An inspection system according to claim 52 and wherein the optical array, the illumination subsystem and the stage are configured and arranged to sequentially view the object and wherein in one view a selected non-zero order of diffraction impinges on the optical array, and in other sequential views at least one of the following impinges on the optical array: a zero'th order of diffraction, an additional non-zero'th order of diffraction, the same non-zero'th order of diffraction of a different region of the surface of the article, and no order of diffraction.

54. An inspection system according to any of claims 43 – 53 and also comprising an image analyzer receiving an output from said non-scanning optical array and being operative to detect process defects including at least one of: uneven deposition of coatings, uneven removal of coatings, rinse residues, chemical residues, incomplete exposure of a photo-resist deposited on the substrate, scratches, lines, and particles embedded in the substrate.

55. An inspection system according to any of claims 43 - 54 and wherein said optical array views substantially all of a surface of said substrate.

56. An inspection system according to any of claims 43 - 54 and wherein said optical array views only a part of a surface of said substrate.

57. An inspection system according to any of claims 43 – 56 and wherein said optical array acquires at least one image of said substrate for each of a plurality of different illuminations.

58. An inspection system according to claim 54 in which image analyzer identifies said defects by computer analysis of a plurality of images of said substrate taken under differing illuminations.

59. An inspection system according to any of claims 43 - 58 and also comprising an enclosure containing a first plurality of illuminators mounted on one wall thereof and a second plurality of illuminators mounted on a second wall thereof.

60. An inspection system according to claim 59 and also comprising a third illuminator mounted on a third wall of said enclosure.

61. An inspection system according to any of claims 43 - 60 and also comprising a diffuser associated with said illumination subsystem.

62. An inspection system according to any of claims 50 – 58 and also comprising a light source and a reflector operative to provide concentrated light from the light source to at least part of said surface.

63. An inspection system according to claim 62 wherein said reflector has two points of focus, and wherein a projector is situated at a first focus, and a second focus is situated not on the surface.

64. An inspection system according to claim 63 and wherein the reflector is a section of an ellipsoid.

65. An inspection system according to claim 64 and wherein the reflector is flat and is operatively associated with a lens.

66. An inspection system according to claim 65 and wherein the lens is a fresnel lens attached to the reflector.

67. An inspection system according to any of claims 44 - 58 and also comprising a light source and a lens operative to provide concentrated light from the light source to at least part of said flat panel display substrate.

68. An inspection system according to claim 67 wherein a projector is situated at a first focus of the lens, and a second focus of the lens is situated not on the flat panel display substrate.

69. An inspection system according to any of claims 43 - 61 and comprising an adjustable mounting assembly for selectably determining at least one of relative inclination, spatial separation and axial orientation of at least two of said optical array, said illumination subsystem and said substrate.

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70. Apparatus for optically inspecting a substantially planar surface of an article, comprising:

an inspection region;

an illuminator to selectably illuminate a substantially planar surface of an article located in the inspection region with at least two predetermined configurations of illumination;

an image acquisition sub-system comprising at least one non-scanning camera for acquiring images of the surface of the article when illuminated by at least one predetermined configuration of illumination; and

an image analysis subsystem for computer analysis of the images and detecting anomalies in the surface as a function of variations in reflected intensities of illumination.

71. Apparatus for optically inspecting the surface of an article according to claim 70 and also comprising a spatially positionable stage for supporting the article in the

inspection region in selectable orientation relative to the illumination apparatus.

72. Apparatus for optically inspecting the surface of an article according to any of claims 70 – 37, wherein the image analysis subsystem is operative to identify anomalies that are substantially at least as large as the resolution of the camera.

73. Apparatus for coating an article having a substantially planar surface, comprising:

a coating generator operative to generate a coating on a surface of the article;

an illuminator selectably illuminating said surface bearing said coating with at least two predetermined configurations of illumination;

an image acquisition sub-system comprising at least one non-scanning sensor for acquiring images of the surface of the article for each combination of illumination; and

an image analysis subsystem for analyzing the images and detecting anomalies in the surface on the basis of variations in reflected intensities of illumination.

74. Apparatus for inspecting an article in a clean room, comprising:

an inspection device situated in a clean room and including:

an inspection stage selectably positionable by remote control;

at least one non-scanning sensor viewing a part of the entire inspection stage;

an array of illuminators illuminating the part of inspection stage viewed by the sensor;

automated feed apparatus;

a control station situated outside the clean room including a viewer for viewing articles placed in the inspection device, and a controller for positioning the stage and providing selected combinations of illumination to illuminate the article.

75. A method for manufacture of flat panel displays comprising:

providing a plurality of manufacturing devices located in a first controlled airborne particle contamination environment, at least some of said plurality of manufacturing devices each including an enclosure defining a second controlled airborne particle

contamination environment having a lower level of contamination than that of said first controlled airborne particle contamination environment; and

inspecting flat panel display substrates at various stages of the production thereof by said plurality of manufacturing devices at a location within said enclosures defining said second controlled airborne particle contamination environments.

76. A method according to claim 75 and wherein said inspecting step comprises inspecting said substrates prior to transfer thereof out of said second controlled airborne particle contamination environment.

77. A method according to either of claims 75 and 76 and wherein said inspecting step comprises inspecting using non-scanning sensors.

78. A method according to any of claims 75 - 77 and further comprising identifying fabrication process defects occurring during production of flat panel display substrates.

79. A method according to claim 78 and wherein said identifying step comprises identifying process defects including at least one of the following: uneven deposition of coatings, uneven removal of coatings, rinse residues, chemical residues, incomplete exposure of a photo-resist deposited on the substrate, scratches, lines, and particles embedded in the substrate.

80. A method according to any of claims 75 - 79 and wherein said inspecting step comprises inspecting using at least one non-scanning sensor which views substantially all of the surface of said substrate.

81. A method according to claim 80 and wherein said inspecting step comprises inspecting using a plurality of non-scanning sensors wherein each sensor views a portion of the substrate and together the plurality of sensors view substantially the entire surface of said substrate.

82. A method according to any of claims 75 - 81 and wherein said inspecting step comprises illuminating the substrate with an illuminating array operative to provide various combinations of illumination.

83. A method according to claim 82 in which the combinations include at least dark field and substantially bright field illumination.

84. A method according to claim 82 and wherein said inspecting step comprises acquiring at least one image of the substrate for each combination of illumination using said non-scanning sensor.

85. A method according to claim 84 and also comprising performing image analysis of the process defects by computer analysis of a plurality of images of the substrate taken under various ones of said combinations of illumination.

86. A method according to claim 85 and wherein said image analysis step is performed without comparison to an external reference.

87. A method according to any of claims 75 - 86 and wherein said providing step comprises further providing said enclosure with a first plurality of illuminators mounted on a first wall of said enclosure and a second plurality of illuminators mounted on a second wall of said enclosure, orthogonal to said first wall.

88. A method according to any of the preceding claims 75 - 87 and wherein said providing step comprises further providing directionally adjustable illuminators.

89. A method for inspecting flat panel displays comprising:

viewing a flat panel display substrate using a non-scanning optical array; and

sequentially illuminating said flat panel display substrate with dark field and bright field illumination when said optical array views said flat panel display substrate.

90. A method according to claim 89 and wherein said sequentially illuminating step illuminates using various combinations of dark field and bright field illumination of said flat panel display substrate when said optical array views said flat panel display substrate.

91. A method according to claim 90 and also comprising

supporting the substrate with a spatially positionable stage, and spatially positioning the stage at various angles to illuminate the substrate with dark field and bright field illumination.

92. A method according to claim 90 or claim 91 and also comprising:

receiving an output from said non-scanning optical array; and

detecting process defects including at least one of: uneven deposition of coatings, uneven removal of coatings, rinse residues, chemical residues, incomplete exposure of a photo-resist deposited on the substrate, scratches, lines, and particles embedded in the substrate.

93. A method according to any of claims 89 - 92 and wherein said viewing step comprises viewing substantially all of a surface of said substrate.

94. A method according to any of claims 89 - 93 and wherein said viewing step comprises acquiring at least one image of said substrate for each of a plurality of different illuminations.

95. A method according to claim 92 and wherein said detecting step comprises identifying said defects by computer analysis of a plurality of images of said substrate taken under differing illumination.

96. A method according to any of claims 89 - 95 and also comprising providing an enclosure containing a first plurality of illuminators mounted on one wall thereof and a second plurality of illuminators mounted on a second wall thereof.

97. A method according to claim 96 and wherein said providing step also comprises providing a third illuminator mounted on a third wall of said enclosure.

98. A method according to any of claims 89 - 97 and also comprising providing a diffuser associated with said illumination subsystem.

99. A method according to any of claims 89 – 64 and also comprising providing an adjustable mounting assembly for selectably determining at least one of relative inclination, spatial separation and axial orientation of at least two of said optical array, said illumination subsystem and said substrate.

100. A method for inspecting objects comprising:

viewing an object using a non-scanning optical array; and

sequentially illuminating said object with dark field and bright field illumination when said optical array views said object.

101. A method according to claim 96 and wherein said sequentially illuminating step illuminates using various combinations of dark field and bright field illumination of said object when said optical array views said object.

102. A method according to claim 101 and also comprising:

receiving an output from said non-scanning optical array; and

detecting process defects including at least one of: uneven deposition of coatings, uneven removal of coatings, rinse residues, chemical residues, incomplete exposure of a photo-resist deposited on the substrate, scratches, lines, and particles embedded in the substrate.

103. A method according to any of claims 100 – 102 and wherein said viewing step comprises viewing substantially all of a surface of said object.

104. A method according to any of claims 100 – 103 and wherein said viewing step comprises acquiring at least one image of said object for each of a plurality of different illuminations.

105. A method according to claim 102 and wherein said detecting step comprises identifying said defects by computer analysis of a plurality of images of said object taken under differing illumination.

106. A method according to any of claims 100 – 105 and also comprising providing an enclosure containing a first plurality of illuminators mounted on one wall thereof and a second plurality of illuminators mounted on a second wall thereof.

107. A method according to claim 106 and wherein said providing step also comprises providing a third illuminator mounted on a third wall of said enclosure.

108. A method according to any of claims 100 – 107 and also comprising providing a diffuser associated with said illumination subsystem.

109. A method according to any of claims 100 – 108 and also comprising providing an adjustable mounting assembly for selectably determining at least one of relative inclination, spatial separation and axial orientation of at least two of said optical array, said illumination subsystem and said object.

110. A method for optically inspecting the surface of an article having a substantially planar surface, comprising:

defining an inspection region;

selectably illuminating the surface of an article located in the inspection region with at least two predetermined configurations of illumination;

acquiring images of the surface of the article when illuminated by at least one predetermined configuration of illumination using at least one non-scanning camera; and

analyzing the images and detecting anomalies in the surface as a function of

variations in reflected intensities of illumination.

111. A method for optically inspecting the surface of an article according to claim 110 and also comprising supporting the article on a spatially positionable stage in the inspection region, and selectably spatially orienting the stage relative to a predetermined configuration of illumination.

112. A method for optically inspecting the surface of an article according to claim 110 or 111, wherein the analyzing step is operative to identify anomalies that are substantially the same size as the resolution of the non-scanning camera.

113. A method for coating an article having a substantially planar surface, comprising:

generating a coating on a surface of the article;

selectably illuminating said surface bearing said coating with at least two predetermined configurations of illumination;

acquiring images of the surface of the article for each combination of illumination using at least one non-scanning sensor; and

analyzing the images and detecting anomalies in the surface on the basis of variations in reflected intensities of illumination.

114. A method for inspecting an article in a clean room, comprising:

situating an inspection device in the clean room;

selectably positioning an inspection stage of said inspection device by remote control;

viewing substantially the entire inspection stage using at least one non-scanning sensor of said inspection device;

illuminating the inspection stage using an array of illuminators of said inspection device;

placing articles in the inspection device using automated feed apparatus of said inspection device; and

situating a remote controller outside the clean room for viewing articles placed in the inspection device, said remote controller comprising a viewer and a controller for remotely positioning the stage and selecting combinations of illumination.

115. A method for inspecting the surface of an article, comprising the steps of:

placing the article in an inspection region defined by a stage;

illuminating a portion of the surface of the article with at least one configuration of dark field illumination;

acquiring an image of substantially the entire surface for the at least one configuration of dark field illumination;

illuminating the surface with at least one configuration of at least substantially bright field illumination;

acquiring an image of substantially the entire surface for the at least one configuration of at least substantially bright field illumination; and

analyzing the images by computer to determine non uniformities in reflected intensities.

116. The method of claim 115 in which the at least one configuration of dark field illumination comprises a plurality of dark field illumination combinations, and separate images are acquired for each of the combinations.

117. The method of claim 115 in which the at least one configuration of substantially bright illumination comprises a plurality of bright field illumination combinations, and separate images are acquired for each of the combinations.

118. The method of claim 117 comprising the additional step of selecting for each predetermined combination of illumination a predetermined inclination and orientation of the substrate, and acquiring separate images of the surface for each said inclination and axial orientation.

119. The method of claim 115 comprising the additional step of optically treating

the illumination prior to acquiring an image.

120. The method of claim 119 in which the treatment is provided by optical filters.

121. The method of claim 120 in which the optical filters filter light at all but selected wavelengths.

122. The method of claim 120 in which the filters filter light to transmit light having a selected polarization.

123. The method of claim 119 in which the surface is illuminated with a selected combination of broad spectrum illumination and imaged through an optical filter operative to transmit light in a first predetermined spectral range, and subsequently imaged through an optical filter operative to transmit light in a second predetermined spectral range.

124. The method of claim 119 in which the surface is illuminated with a first combination illumination provided in first predetermined spectral range and imaged, and subsequently illuminated with a second combination of illumination provided in a second predetermined spectral range and imaged.

125. The method of claim 119 in which the surface is illuminated with a selected combination of broad spectrum illumination and imaged through an optical filter operative to transmit light in a first predetermined polarization, and subsequently imaged through an optical filter operative to transmit light having a predetermined polarization.

126. The method of claim 119 in which the surface is illuminated with a first combination of illumination having a first predetermined polarization and imaged, and subsequently illuminated with a second combination of illumination having a second predetermined polarization and imaged.

127. The method of claim 115 comprising the additional step of blurring the image

during acquisition.

128. The method of claim 127 in which the at least one image is blurred by introducing relative movement between at least two of the following: the surface, the camera, and an optical element between the surface and the camera.

129. The method of claim 115 comprising the further step of analyzing said non-uniformities by computer to determine the presence of defects in coatings on the substrate.

130. The method of claim 115 in which the article is a flat display panel substrate.

131. A method for coating the surface of an article with a film, comprising the steps of:

depositing a film coating on at least part of a surface of the article; placing the article in an inspection region;

illuminating a portion of the coated surface of the article with at least one configuration of dark field illumination;

acquiring an image of the surface illuminated by the at least one configuration of dark field illumination;

illuminating the surface with at least one configuration of substantially bright field illumination;

acquiring an image of the entire surface illuminate by the least one configuration of substantially bright field illumination; and

analyzing each image by computer to determine non uniformities in reflected intensities.

132. Apparatus for automatic optical inspection of generally flat articles having at least one generally periodic spatial feature, comprising:

a light beam generator providing an illuminating beam of light along an illuminating light beam axis onto a generally flat article having at least one at least generally periodic spatial feature; and

a sensor viewing the article along a light receiving axis disposed at an angle with respect to the illumination light beam axis whereby a generally non-zero'th orders of diffracted light reflected from said article impinges on a lens of said sensor.

133. Apparatus according to claim 132 and wherein the sensor is a staring array sensor operative to view at least a portion of the article.

134. Apparatus according to either of claims 132 and 133 and also comprising a postioner for changing the spatial orientation of the generally flat article with respect to the illumination light beam axis and said light receiving axis.

135. Apparatus according to claim 133 and wherein said positioner is operative to selectably spatially position the generally flat article so that it lies in a plane which is angularly inclined to the plane defined by the illuminating light beam axis and the light receiving axis.

136. Apparatus according to claim 135 and wherein said positioner is operative to selectively provide various spatial orientations of the flat article so that a sequence of various non-zero'th orders of diffracted light from the illuminating beam impinge on said sensor.

137. Apparatus according to claim 135 and wherein said positioner is operative to selectively provide various spatial orientations of the flat article so that a non-zero'th order of diffracted light from the illuminating beam impinges on said sensor, and in sequence at least one of the following orders of diffracted light from the illuminating beam impinges on said sensor: an additional non-zero'th order, a zero'th order, no order.

138. Apparatus according to and of preceding claims 134 – 137 and wherein said sensor acquires an image of the article for each spatial orientation of the article.

139. A method for automatic optical inspection of generally flat articles having at least one generally periodic spatial feature, comprising:

generating an illuminating beam of light along an illuminating light beam axis onto a generally flat article having at least one at least generally periodic spatial feature; and

sensing light reflected by the article along a light receiving axis disposed at an angle with respect to the illumination light beam axis whereby a generally non-zero'th order of diffracted light reflected from said article impinges on a lens of said sensor.

140. A method according to claim 139 and wherein the sensing step is performed using a staring array sensor operative to view at least a portion of the article.

141. A method according to either of claims 139 and 140 and also comprising changing the spatial orientation of the generally flat article with respect to the illumination light beam axis and said light receiving axis.

142. A method according to claim 140 and wherein said changing spatial orientation step includes selectably positioning the generally flat article so that it lies in a plane which is angularly inclined to the plane defined by the illuminating light beam axis and the light receiving axis.

143. A method according to claim 142 and wherein the spatial orientation step includes selectively providing various spatial orientations of the flat article so that a sequence of various non-zero'th orders of diffracted light from the illuminating beam impinge on said sensor.

144. Apparatus according to claim 142 and wherein the spatial orientation step includes selectively providing various spatial orientations of the flat article so that a non-zero'th order of diffracted light from the illuminating beam impinges on said sensor, and in sequence at least one of the following orders of diffracted light from the illuminating beam impinges on said sensor: an additional non-zero'th order, a zero'th order, no order.

145. Apparatus according to any of preceding claims 141 – 144 and wherein said sensing step includes acquiring an image of the article for each spatial orientation of the

article.

146. A method for manufacturing flat panel displays comprising the steps of:

providing a first controlled environment in which an airborne particle controlled environment having a first level of controlled airborne particulate contamination, and a second controlled environment in which an airborne particle controlled environment having a second level of controlled airborne particulate contamination is less than the first level of controlled airborne particulate contamination.

147. A method according to claim 89 and wherein said dark field and said bright field illumination are diffuse.

148. A method according to claim 89 and wherein said dark field and said bright field illumination are focussed.

149. A method according to claim 148 and wherein said flat panel display substrate has a surface that includes a periodic spatial feature, and said dark field and said bright field illumination are diffracted by said spatial feature.

150. A method according to claim 99 and wherein the optical array, illumination subsystem and stage are configured and arranged to selectively enable viewing the flat panel display substrate such that a non-zero'th order of diffraction impinges on the non-scanning optical array.

151. A method according to claim 150 and wherein a multiplicity of the non-zero'th orders of diffraction of a similar order impinge on said non-scanning optical array.

152. A method according to either of claims 150 and 151 and wherein the optical array, the illumination subsystem and the stage are configured and arranged to additionally enable selectively viewing the flat panel display substrate such that a zero'th order of diffraction impinges on the non-scanning optical array.

153. A method according to any of claims 150 – 152 and wherein the optical array the illumination subsystem and the stage are configured and arranged to additionally enable selective viewing of the flat panel display substrate such that substantially no orders of diffraction impinge on the non-scanning optical array.

154. A method according to claim 153 and wherein the optical array and the illumination subsystem are configured and arranged to sequentially view the flat panel display substrate and wherein in one view a selected non-zero'th order of diffraction impinges on the optical array, and in other each sequential views at least one of the following impinges on the optical array: a zero'th order of diffraction, an additional selected non-zero'th order of diffraction, no order of diffraction, the same non-zero'th order of diffraction of a different region of the article.

155. A method according to any of claims 89 – 95 and also comprising providing a light source and a reflector operative to provide concentrated light from the light source to at least part of said flat panel display substrate.

156. A method according to claim 155 wherein said reflector has two points of focus, and wherein a projector is situated at a first of points of focus, and the second point of focus is situated away from the flat panel display substrate.

157. A method according to claim 156 and wherein the reflector is a section of an ellipsoid.

158. A method according to claim 156 and wherein the reflector is flat and is operatively associated with a lens.

159. A method according to claim 158 and wherein the lens is a fresnel lens attached to the reflector.

160. A method according to any of claims 89 – 95 and also comprising providing a light source and a lens operative to provide concentrated light from the light source to at least part of said flat panel display substrate.

161. A method according to claim 160 wherein the projector is situated at a first focus of the lens. and a second focus of the lens is situated away from the flat panel display substrate.

162. A method according to claim 90 and wherein said dark field and said bright field illumination are diffuse .

163. A method according to claim 90 and wherein said dark field and said bright field illumination are focussed.

164. A method according to claim 163 and wherein said surface includes a periodic spatial feature operative to diffract light impinging thereon.

165. A method according to any of claims 89, 90 and 160 - -164 and also comprising providing a spatially positionable stage to support the article, wherein the stage spatially positions the article at various angles relative to the illumination subsystem.

166. A method according to claim 165 and wherein the optical array, illumination subsystem and stage are configured and arranged to selectively enable viewing the surface such that a non-zero'th order of diffraction impinges on the non-scanning optical array.

167. A method according to claim 166 and wherein a multiplicity of non-zero'th orders of diffraction of substantially the same order impinge on the non-scanning optical array.

168. A method according to either of claims 166 and 167 and wherein the optical array, the illumination subsystem and the stage are configured and arranged to additionally

enable selectively viewing of the surface such that a zero'th order of diffraction impinges on the non-scanning optical array.

169. A method according to any of claims 166 – 168 and wherein the optical array the illumination subsystem and the stage are configured and arranged to additionally enable selectively viewing the object such that substantially no orders of diffraction impinge on the non-scanning optical array.

170. A method according to claim 169 and wherein the optical array, the illumination subsystem and the stage are configured and arranged to sequentially view the object and wherein in one view a selected non-zero order of diffraction impinges on the optical array, and in other sequential views at least one of the following impinges on the optical array: a zero'th order of diffraction, an additional non-zero'th order of diffraction, the same non-zero'th order of diffraction of a different region of the surface of the article, and no order of diffraction.

171. A method according to any of claims 89 - 92 and wherein said optical array views only a part of a surface of said substrate.

172. A method according to any of claims 89 – 95 and 167 – 169 and also comprising providing a light source and a reflector operative to provide concentrated light from the light source to at least part of said surface.

173. A method according to claim 172 wherein said reflector has two points of focus, and wherein a projector is situated at a first focus, and a second focus is situated not on the surface.

174. A method according to claim 173 and wherein the reflector is a section of an ellipsoid.

175. A method according to claim 174 and wherein the reflector is flat and is

operatively associated with a lens.

176. A method according to claim 175 and wherein the lens is a fresnel lens attached to the reflector.

177. A method according to any of claims 89 - 95 and also comprising providing a light source and a lens operative to provide concentrated light from the light source to at least part of said flat panel display substrate.

178. A method according to claim 177 providing a projector which is situated at a first focus of the lens, and a second focus of the lens is situated not on the flat panel display substrate.

179. A method according to any of claims 75 - 79 and wherein said optical array views only part of a surface of said substrate.